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September 25, 2000

BOX PATENT APPLICATION
Assistant Commissioner for Patents
Washington, D.C. 20231

Re: Application of Hideo WATANABE, Yasumasa SHIMIZU, and Akira KAWATA
SOLID MULTI-PIECE GOLF BALL
Our Reference: Q60969

Dear Sir:

Attached hereto is the application identified above including 14 pages of the specification, claims, and abstract, one (1) sheet of formal drawings (Figure 1), executed Assignment and PTO 1595 form, and executed Declaration and Power of Attorney. Also enclosed is the Information Disclosure Statement.

The Government filing fee is calculated as follows:

| | | | | | | | |
|--------------------|--------|---|--|---|---------|---|----------|
| Total claims | 7 - 20 | = | | x | \$9.00 | = | \$0.00 |
| Independent claims | 1 - 3 | = | | x | \$39.00 | = | \$0.00 |
| Base Fee | | | | | | | \$690.00 |


| | |
|---------------------------|-----------------|
| TOTAL FILING FEE | \$690.00 |
| Recordation of Assignment | \$40.00 |
| TOTAL FEE | \$730.00 |

Checks for the statutory filing fee of \$690.00 and Assignment recordation fee of \$40.00 are attached. You are also directed and authorized to charge or credit any difference or overpayment to Deposit Account No. 19-4880. The Commissioner is hereby authorized to charge any fees under 37 C.F.R. §§ 1.16 and 1.17 and any petitions for extension of time under 37 C.F.R. § 1.136 which may be required during the entire pendency of the application to Deposit Account No. 19-4880. A duplicate copy of this transmittal letter is attached.

Priority is claimed from September 30, 1999, based on Japanese Application No. 11-278451. The priority document is enclosed herewith.

Respectfully submitted,
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By: 
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TITLE OF THE INVENTION
Solid Multi-Piece Golf Ball

5 The present invention relates to a golf ball having a good feel when hit with various types of golf clubs and improved distance when hit with a driver.

10 BACKGROUND OF THE INVENTION

One of the performance attributes desired in a golf ball is a good feel when the ball is hit. Many attempts have been made to achieve a soft feel by reducing the hardness of the cover, but the soft feel in such cases is often attained at the expense of distance.

On the other hand, improving the distance of the ball generally requires that the cover be made harder, yet a hard cover compromises the feel of the ball on putter and approach shots.

20 The problem of how to improve both the feel and the distance of a solid golf ball has thus been regarded as intractable.

To this end, we earlier proposed, in Japanese Patent No. 2,658,811, a golf ball having a three-layer construction comprising a center core, an intermediate layer and a cover which effectively resolves this impasse by achieving both an excellent feel and improved distance. Moreover, there is proposed, in U.S. Patent Application No. 09/390,290, a multi-piece solid golf ball comprising a solid core, an intermediate layer of at least one layer around the core, and a cover of at least one layer around the intermediate layer, wherein the solid core has a deflection A (mm) under an applied load of 100 kg, and a spherical body consisting of the core and the intermediate layer has a deflection B (mm) under an applied load of 100 kg, the value of B/A being from 1.0 to 1.5. But the high expectations golfers have of

the golf balls they use continues to create a need for balls of even better performance.

SUMMARY OF THE INVENTION

5 It is therefore an object of the present invention to provide a golf ball which has a good feel when hit with various types of clubs and improved distance when struck with a driver.

10 It has been found that a solid multi-piece golf ball comprising a solid core, a mantle of at least one layer enclosing the solid core and a cover of at least one layer enclosing the mantle, wherein the compressions of the mantle and the solid core are set such as to make the mantle softer and more resilient than in the foregoing prior-art golf
15 balls and the core is given a suitable hardness distribution, has an excellent feel that is very soft on putter and approach shots, even when the cover itself is hard. Moreover, it has also been found that such a ball, when hit with a driver, has a good feel and can achieve an increased
20 distance of travel. Hence, the ball is endowed with an excellent balance of distance and feel.

 Accordingly, the invention provides a solid multi-piece golf ball comprising a solid core, a mantle of at least one layer enclosing the solid core, and a cover of at
25 least one layer enclosing the mantle. The mantle and the solid core have a compression ratio, defined as (compression of mantle)/(compression of solid core), of at least 0.98. The solid core has a surface and a center with a difference in JIS-C hardness therebetween, defined as (surface hardness
30 - center hardness), of at least 5.

 Preferably, the mantle is made of a material composed primarily of a thermoplastic resin and has a thickness of up to 1.5 mm. The cover typically is made of a material composed primarily of a thermoplastic resin having a Shore D
35 hardness of 60 to 68.

The solid core has a compression of preferably from 3.2 to 4.5 mm, and the compression ratio between the mantle and the solid core is preferably at least 1.00.

The JIS-C hardness difference between the surface and
5 the center of the solid core is preferably at least 8.

BRIEF DESCRIPTION OF THE DRAWING

The only figure, FIG. 1 is a sectional view showing a solid golf ball according to one embodiment of the invention.

10

DETAILED DESCRIPTION OF THE INVENTION

Referring to FIG. 1, the golf ball of the invention has a multilayer construction comprising a solid core 1, a mantle 2 enclosing the solid core 1, and a cover 3 enclosing
15 the mantle 2. In FIG. 1, the solid core 1, mantle 2 and cover 3 are each composed of a single layer, although any or all of these parts of the ball may have a construction composed of two or more layers of different materials.

The solid core 1 may be made of a known rubber
20 composition, and preferably one in which polybutadiene is used as the base material. The use of 1,4-polybutadiene having cis configuration of at least 40% is especially suitable.

A crosslinking agent may be included in the rubber
25 composition. Exemplary crosslinking agents include the zinc and magnesium salts of unsaturated fatty acids, such as zinc methacrylate and zinc acrylate, and ester compounds such as trimethylpropane methacrylate. Zinc acrylate is especially preferred for achieving a high resilience. The crosslinking
30 agent is preferably included in an amount of 10 to 35 parts by weight per 100 parts by weight of the base rubber.

A vulcanizing agent such as dicumyl peroxide or a mixture of dicumyl peroxide and 1,1-bis(t-butylperoxy)-3,3,5-trimethylcyclohexane is generally included in the
35 rubber composition. The amount of vulcanizing agent included in the rubber composition is preferably from 0.1 to 5 parts by weight per 100 parts by weight of the base rubber.

Advantageous can be use of a commercial product such as Percumyl D (manufactured by Nippon Oils and Fats Co., Ltd.) as the dicumyl peroxide.

If necessary, other suitable ingredients may also be incorporated in the rubber composition, such as antioxidants and fillers (e.g., zinc oxide, barium sulfate) for modifying the specific gravity. The amount of such fillers included in the composition is typically from 0 to 130 parts by weight per 100 parts by weight of the base rubber.

The solid core may be produced from the above rubber composition by using a conventional blending apparatus such as a Banbury mixer, kneader or roll mill to blend the ingredients into a compound, then injection-molding or compression-molding the compound in a core mold.

It is recommended that the resulting solid core have a diameter of generally at least 32.0 mm, and preferably at least 35.0 mm, but not more than 38.7 mm, and preferably not more than 37.0 mm.

In the practice of the invention, it is essential for the solid core to have a compression in a given ratio with respect to the compression of the mantle. "Compression," as used herein, refers to the amount of deflection, or deformation, a ball or ball component incurs when subjected to a load of 1,275 N (130 kgf) from an initial load of 98 N (10 kgf). The compression of the solid core is adjusted in accordance with the compression of the mantle and should preferably be at least 3.2 mm, and more preferably at least 3.5 mm, but not more than 4.5 mm, and more preferably not more than 4.2 mm. A solid core having too soft compression may give the golf ball insufficient rebound and thus result in a shortened distance of travel. On the other hand, a solid core with a compression that is too hard may cause the ball to incur excessive spin on impact with a driver, which can also shorten the distance of travel by the ball.

Not only must the solid core have a compression which provides an appropriate compression ratio, it must also have a suitable distribution in JIS-C hardness. Namely, it is

critical for the solid core to have a JIS-C hardness at the surface thereof which is greater than the JIS-C hardness at the center of the core, and for the difference in JIS-C hardness therebetween, defined as (surface hardness - center hardness), to be at least 5, and preferably at least 8. Too small a difference in the JIS-C hardness within the solid core may result in excessive spin by the ball, lowering the distance of travel. It is recommended that the upper limit in the difference in JIS-C hardness be not more than 22, and preferably not more than 20.

In the golf ball of the invention, the solid core may be made of a material other than the rubber composition described above, in which case the material should be suitably modified to give the above-described hardness distribution within the solid core and the above-described ratio in mantle compression to solid core compression, such as by the use of the thermoplastic resins mentioned subsequently as mantle materials and cover materials.

The mantle 3, as shown in FIG. 1, is an intermediate layer between the solid core 1 and the cover 3. In the practice of the invention, a mantle which is a soft layer having the compression indicated below and which is preferably formed to a low thickness provides, in association with the above-described hardness distribution in the solid core, synergistic effects that enhance the flight performance and feel of the inventive golf ball.

The mantle may be formed of a known thermoplastic resin. For example, preferred use can be made of a resin composed primarily of a thermoplastic elastomer. Illustrative examples include polyester, polyamide, polyurethane, polyolefin, polystyrene and other thermoplastic elastomers. Specific commercial products that may be used for this purpose include Hytrel (DuPont-Toray Co., Ltd.), Pelprene (Toyobo Co., Ltd.), Pebax (Toray industries, Inc.), Pandex (Dainippon Ink & Chemicals, Inc.), Santoprene (Monsanto Chemical Co.) and Tuftec (Asahi Kasei Kogyo Co., Ltd.).

When the foregoing thermoplastic elastomer is used, the Shore D hardness of the elastomer proper is not subject to any particular limitation. Use may be made of a relatively soft material generally having a Shore D hardness of at least 15, and preferably at least 25, more preferably at least 30, but not more than 50, and preferably not more than 40. An especially preferred example of a commercial product which may be used for this purpose is Hytrel 3078 (DuPont-Toray Co., Ltd.) having a Shore D hardness of 30.

The mantle may be formed by injection-molding the above-described material using a process wherein a prefabricated solid core is placed at a predetermined position within an injection mold, following which the mantle-forming material is introduced into the mold. Alternatively, use may be made of a compression molding process in which a pair of hemispherical cups are fashioned from the above material, following which the cups are placed over a solid core and molded under heat and pressure in a mold.

No particular limitation is imposed on the thickness to which the mantle is formed. However, to reliably enhance the feel and distance performance of the ball, it is recommended that the mantle have a thickness which is not more than 1.5 mm and preferably not more than 1.3 mm, but at least 0.2 mm, and preferably at least 0.8 mm.

In the practice of the invention, it is critical for the ratio between the compression of the mantle and the compression of the solid core, defined as (mantle compression/solid core compression), to be adjusted so as to be at least 0.98, and preferably at least 1.00. At a compression ratio lower than 0.98, an optimal feel on taking a putter or iron shot cannot be achieved. It is generally advantageous for the compression ratio to be no higher than 1.08, and especially 1.05. A compression ratio which is too high may lower the ball's resilience and thus reduce the distance traveled by the ball.

The mantle preferably has a compression of at least 3.2 mm, and more preferably at least 3.5 mm, but not more than 4.5 mm, and more preferably not more than 4.2 mm.

In the golf ball of the invention, the surface of the
5 above-described mantle 2 is enclosed within a cover 3 which
may be made of a known material composed primarily of a
thermoplastic resin. Exemplary cover materials include
ionomer resins such as the commercial products Himilan
(DuPont-Mitsui Polychemicals Co., Ltd.), Surlyn (E.I. DuPont
10 de Nemours and Company) and Iotek (Exxon Chemical Company).

It is recommended that the cover be made of a
thermoplastic resin which gives the cover a Shore D hardness
of at least 60, and preferably at least 62, but not more
than 68, and preferably not more than 65. At a low Shore D
15 hardness, the resilience of the ball may decline and the
spin may increase, resulting in a reduced distance of travel.
On the other hand, too high a Shore D hardness tends to give
the ball a hard feel when hit.

The above-described primary constituent of the cover
20 may have compounded therewith suitable amounts of various
additives such as inorganic fillers. Examples of inert
fillers that may be used include barium sulfate and titanium
dioxide. Inorganic fillers such as these may also be
surface treated to facilitate dispersion within the cover
25 material.

The cover may be fashioned from the above material by
a process similar to the processes described above for
forming the mantle, such as injection molding or compression
molding. For example, when an injection molding process is
30 used, the solid core over which the mantle has been formed
is placed in an injection mold, following which the cover
material is introduced into the mold and molded over the
mantle.

The thickness of the resulting cover is not subject to
35 any particular limitation. However, it is advisable to form
the cover to a thickness of generally at least 0.2 mm, and

preferably at least 1.0 mm, but not more than 5.0 mm and preferably not more than 2.5 mm.

As in conventional golf balls, the golf ball of the invention has numerous dimples formed on the surface of the cover. If necessary, the surface may be subjected to finishing treatment such as painting and stamping.

No particular limitation is imposed on the compression of the inventive golf ball itself. However, it is generally advisable for this to be at least 2.2 mm, and preferably at least 2.5 mm, but not more than 3.5 mm, and preferably not more than 3.2 mm.

The golf ball of the invention may be formed so as to have a diameter and weight which conform with the Rules of Golf. That is, the ball may have a diameter of at least 42.67 mm and a weight of not more than 45.93 g.

The inventive golf ball has a good feel when hit with various types of golf clubs and improved distance when struck with a driver.

EXAMPLE

Examples of the invention and comparative examples are given below by way of illustration, and are not intended to limit the invention.

Examples and Comparative Examples

In each example, the rubber composition shown in Table 1 was introduced into a core mold to produce a solid core having the hardness distribution indicated in the table. Next, a mantle and/or cover was formed using the materials shown in Table 2 in accordance with the specifications of Table 3, giving golf balls bearing dimples in the same arrangement and shape on the surface.

The trade names mentioned in Table 2 represent the following materials.

Hytre1: A thermoplastic polyester elastomer made by DuPont-Toray Co., Ltd.

Pelprene: A thermoplastic polyester elastomer made by Toyobo Co., Ltd.

Himilan: An ionomer resin made by DuPont-Mitsui Polychemicals Co., Ltd.

5 The properties of the golf balls obtained in the examples were measured and evaluated as described below. The results are shown in Table 3.

Compression:

10 The compression was determined by measuring the amount of deflection, or deformation, by the ball or ball component being measured when subjected to a load of 1275 N (130 kgf) from an initial load of 98 N (10 kgf).

Performance:

15 The golf balls obtained in each example were measured for spin rate, carry and total distance when hit with a driver (W#1) at a head speed of 40 m/s using a swing robot. Flight performance was rated as follows based on the total distance of each ball.

20 VG: Very good flight (total distance of at least 195 m)

 Good: Good flight (total distance of at least 193 m but less than 195 m)

 Poor: Poor (total distance of less than 193 m)

Feel:

25 The feel of each ball when hit with a driver (W#1), No. 9 iron (I#9) and a putter was rated as follows.

 VG: Very good

 Good: Good, soft feel

 Fair: Somewhat hard

30 Poor: Hard

Table 1

| Core composition (parts by weight) | | EX | | | | CE | | | | |
|----------------------------------------------------|----------------------------|-------|-------|-------|-------|-------|------|------|-------|-------|
| | | 1 | 2 | 3 | 4 | 1 | 2 | 3 | 4 | 5 |
| Polybutadiene | | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| Zinc diacrylate | | 25.5 | 25.5 | 26.2 | 26.2 | 26.2 | 29.0 | 24.5 | 26.2 | 23.6 |
| Dicumyl peroxide | | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Antioxidant | | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 |
| Barium sulfate | | 17.31 | 18.93 | 19.88 | 19.28 | 17.55 | 16.7 | 18.7 | 16.94 | 17.96 |
| Zinc oxide | | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 |
| Zinc salt of pentachlorothio- phenol | | 0.1 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.1 |
| Primary vulcani- zation condi- tions | Temp. (°C) | 155 | 155 | 155 | 155 | 155 | 155 | 155 | 145 | 155 |
| | Time (min) | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 30 | 15 |
| Secondary vulcani- zation condi- tions | Temp (°C) | | | | | | | | 170 | |
| | Time (min) | | | | | | | | 10 | |
| Core hardness (JIS-C) | (1) Surface hardness | 72 | 72 | 73 | 73 | 73 | 76 | 71 | 70 | 72 |
| | (2) Center hardness | 63 | 63 | 63 | 63 | 63 | 66 | 62 | 67 | 63 |
| | (1)-(2) | 9 | 9 | 10 | 10 | 10 | 10 | 9 | 3 | 9 |

5

Table 2

| Mantle and cover compositions (pbw) | a | b | c | d | e |
|----------------------------------------|-------|-------|-------|-------|-------|
| Hytrel 3078 | 100 | | | | |
| Hytrel 4047 | | 100 | | | |
| Hytrel 4767 | | | 100 | | |
| Pelprene P30B | | | | 100 | |
| Himilan 1706 | | | | | 50 |
| Himilan 1605 | | | | | 50 |
| Titanium dioxide | | | | | 5.6 |
| Resin hardness (Shore D) | 30 | 40 | 47 | 25 | 63 |
| Specific gravity | 1.080 | 1.121 | 1.157 | 1.050 | 0.985 |

Table 3

| | | EX | | | | CE | | | | |
|---------------------------------|--------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| | | 1 | 2 | 3 | 4 | 1 | 2 | 3 | 4 | 5 |
| Solid core | Weight (g) | 28.74 | 28.97 | 29.14 | 28.01 | 26.81 | 27.65 | 27.53 | 28.74 | 35.07 |
| | Diameter(mm) | 36.11 | 36.11 | 36.11 | 35.68 | 35.25 | 35.59 | 35.54 | 36.11 | 38.60 |
| | Compression (mm) | 4.01 | 4.01 | 3.91 | 3.91 | 3.89 | 3.49 | 4.16 | 3.9 | 4.0 |
| Mantle | Type | b | a | d | a | b | c | c | a | |
| | Hardness (Shore D) | 40 | 30 | 25 | 30 | 40 | 47 | 47 | 40 | |
| | Weight (g) | 35.07 | 35.07 | 35.07 | 35.07 | 35.07 | 35.07 | 35.07 | 35.07 | |
| | Diameter(mm) | 38.68 | 38.68 | 38.68 | 38.68 | 38.68 | 38.56 | 38.56 | 38.68 | |
| | Compression (mm) | 4.05 | 4.13 | 4.05 | 3.82 | 3.71 | 3.18 | 3.8 | 4.03 | |
| Cover | Type | e | e | e | e | e | e | e | e | e |
| Compression ratio (mantle/core) | | 1.01 | 1.03 | 1.04 | 0.98 | 0.95 | 0.91 | 0.91 | 1.03 | - |
| Ball | Weight (g) | 45.3 | 45.3 | 45.3 | 45.3 | 45.3 | 45.3 | 45.3 | 45.3 | 45.3 |
| | Diameter(mm) | 42.7 | 42.7 | 42.7 | 42.7 | 42.7 | 42.7 | 42.7 | 42.7 | 42.7 |
| | Compression (mm) | 3.15 | 3.23 | 3.15 | 3.10 | 3.00 | 2.53 | 2.90 | 3.16 | 3.06 |
| W#1 (HS =40) | Carry (m) | 185.0 | 185.3 | 185.2 | 184.7 | 185.1 | 185.0 | 184.5 | 182.4 | 184.0 |
| | Total distance (m) | 195.5 | 194.1 | 193.3 | 193.2 | 194.7 | 194.3 | 194.7 | 189.6 | 194.9 |
| | Flight performance | VG | Good | Good | Good | Good | Good | Good | Poor | Good |
| | Spin (rpm) | 2727 | 2825 | 2875 | 2830 | 2785 | 2735 | 2638 | 3075 | 2670 |
| | Feel | Good | Good | Good | Good | Good | Fair | Good | Good | Good |
| I#9 | Feel | Good | Good | VG | VG | Good | Fair | Fair | Good | Fair |
| Putter | Feel | Good | Good | Good | Good | Fair | Fair | Fair | Good | Poor |

As is apparent from the results in Table 3, the golf balls according to the invention all had an excellent flight performance and a good feel when hit with different types of golf clubs. By contrast, the golf balls obtained in the comparative examples had the following drawbacks.

Comparative Example 1: The ball had a somewhat hard feel when hit with a putter.

Comparative Example 2: The ball had a somewhat hard feel when hit with a driver, an iron or a putter.

Comparative Example 3: The ball had a somewhat hard feel when hit with an iron and when hit with a putter.

Comparative Example 4: The flight performance of the ball when struck with a driver was the poorest of all the examples and comparative examples.

Comparative Example 5: The ball had a somewhat hard feel when hit with an iron, and an even harder feel when hit with a putter.

Japanese Patent Application No. 11-278451 is incorporated herein by reference.

Although some preferred embodiments have been described, many modifications and variations may be made thereto in light of the above teachings. It is therefore to be understood that the invention may be practiced otherwise than as specifically described without departing from the scope of the appended claims.

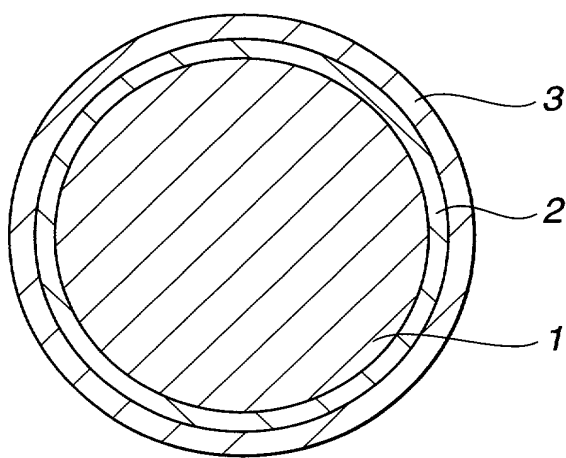
CLAIMS:

1. A solid multi-piece golf ball comprising a solid core,
a mantle of at least one layer enclosing the solid core, and
5 a cover of at least one layer enclosing the mantle, wherein
the mantle and the solid core have a compression ratio,
defined as (compression of mantle)/(compression of solid
core), of at least 0.98, and
the solid core has a surface and a center with a
10 difference in JIS-C hardness therebetween, defined as
(surface hardness - center hardness), of at least 5.
2. The golf ball of claim 1, wherein the mantle is made
of a material composed primarily of a thermoplastic resin.
- 15 3. The golf ball of claim 1, wherein the mantle has a
thickness of up to 1.5 mm.
4. The golf ball of claim 1, wherein the cover is made of
20 a material composed primarily of a thermoplastic resin
having a Shore D hardness of 60 to 68.
5. The golf ball of claim 1, wherein the solid core has a
compression of 3.2 to 4.5 mm.
- 25 6. The golf ball of claim 1, wherein the compression
ratio between the mantle and the solid core is at least 1.00.
7. The golf ball of claim 1, wherein the JIS-C hardness
30 difference between the surface and the center of the solid
core is at least 8.

ABSTRACT

In a solid multi-piece golf ball comprising a solid
5 core, a mantle, and a cover, the ratio of the compression of
the mantle to the compression of the solid core is at least
0.98, and the difference in JIS-C hardness between the
surface and the center of the solid core is at least 5.
This construction and combination of features provide the
10 ball with a good feel when hit with various types of golf
clubs and improved distance when struck with a driver.

FIG.1



DECLARATION AND POWER OF ATTORNEY

As a below named inventor, I hereby declare that my residence, post office address and citizenship are as stated below next to my name: that I verily believe I am the original, first and sole inventor (if only one name is listed below) or a joint inventor (if plural names are listed below) of the subject matter claimed and for which a patent is sought in the application entitled:

Solid Multi-Piece Golf Ball

which application is:

x the attached application
(for original application)

_____ application Serial No. _____
filed _____, and amended on _____

(for declaration not accompanying application)

that I have reviewed and understand the contents of the specification of the above-identified application, including the claims, as amended by any amendment referred to above; that I acknowledge my duty to disclose information of which I am aware which is material to the patentability of this application under 37 C.F.R. 1.56, that I hereby claim foreign priority benefits under Title 35, United States Code §119, §172 or §365 of any foreign application(s) for patent or inventor's certificate listed below and have also identified on said list any foreign application for patent or inventor's certificate on this invention having a filing date before that of the application on which priority is claimed:

| Application Number | Country | Filing Date | Priority Claimed (yes or no) |
|--------------------|---------|--------------------|---------------------------------|
| 11-278451 | Japan | September 30, 1999 | yes |

I hereby claim the benefit of Title 35, United States Code §120 of any United States application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in a listed prior United States application in the manner provided by the first paragraph of Title 35, United States Code, §112, I acknowledge my duty to disclose any information material to the patentability of this application under 37 C.F.R. 1.56 which occurred between the filing date of the prior application and the national or PCT international filing date of this application:

| Application Serial No. | Filing Date | Status (patented, pending, abandoned) |
|------------------------|-------------|------------------------------------------|
|------------------------|-------------|------------------------------------------|

I hereby appoint John H. Mion, Reg. No. 18,879; Donald E. Zinn, Reg. No. 19,046; Thomas J. Macpeak, Reg. No. 19,292; Robert J. Seas, Jr., Reg. No. 21,092; Darryl Mexic, Reg. No. 23,063; Robert V. Sloan, Reg. No. 22,775; Peter D. Olexy, Reg. No. 24,513; J. Frank Osha, Reg. No. 24,625; Waddell A. Biggart, Reg. No. 24,861; Robert G. McMorrow, Reg. No. 19,093; Louis Gubinsky, Reg. No. 24,835; Neil B. Siegel, Reg. No. 25,200; David J. Cushing, Reg. No. 28,703; John R. Inge, Reg. No. 26,916; Joseph J. Ruch, Jr., Reg. No. 26,577; Sheldon I. Landsman, Reg. No. 25,430; Richard C. Turner, Reg. No. 29,710; Howard L. Bernstein, Reg. No. 25,665; Alan J. Kasper, Reg. No. 25,426; Kenneth J. Burchfiel, Reg. No. 31,333; Gordon Kit, Reg. No. 30,764; Susan J. Mack, Reg. No. 30,951; Frank L. Bernstein, Reg. No. 31,484; Mark Boland, Reg. No. 32,197; William H. Mandir, Reg. No. 32,156; Scott M. Daniels, Reg. No. 32,562; Brian W. Hannon, Reg. No. 32,778 and Abraham J. Rosner, Reg. No. 33,276, my attorneys to prosecute this application and to transact all business in the Patent and Trademark Office connected therewith, and request that all correspondence about the application be addressed to SUGHRUE, MION, ZINN, MACPEAK & SEAS, 2100 Pennsylvania Avenue, N.W., Washington, D.C. 20037-3202.

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

Date September 4, 2000

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Signature _____
Post Office Address _____

Date _____
Residence _____
Citizenship _____

Fifth Inventor _____
First Name Middle Initial Last Name
Signature _____
Post Office Address _____

Date _____
Residence _____
Citizenship _____

Sixth Inventor _____
First Name Middle Initial Last Name
Signature _____
Post Office Address _____

Date _____
Residence _____
Citizenship _____

Seventh Inventor _____
First Name Middle Initial Last Name
Signature _____
Post Office Address _____